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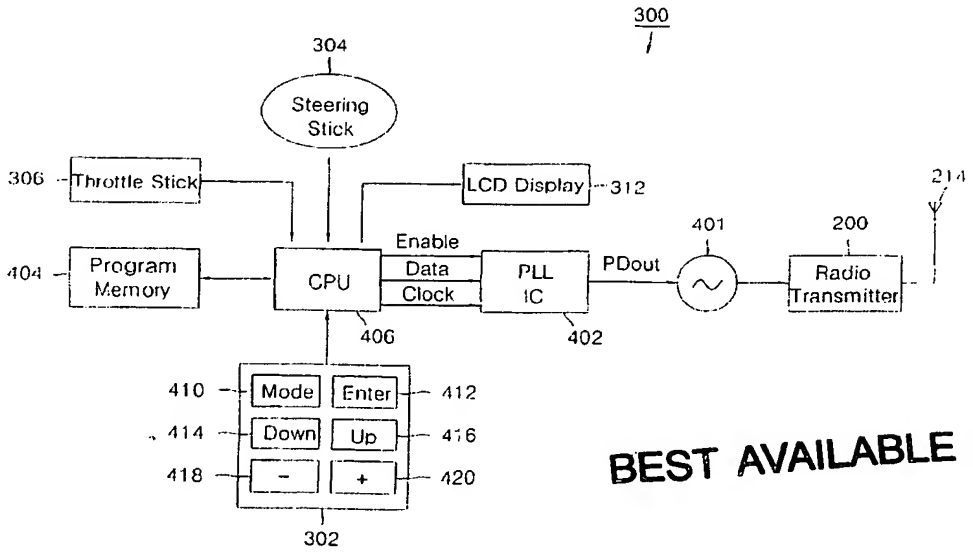

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(57) Abstract: Remote Controller for setting radio-frequency is disclosed. The remote controller comprises an operation panel (302) for manually selecting a value of frequency, a program memory (404) for storing a frequency data, a microprocessor (CPU) (406) for reading out from the program memory (404) the frequency data corresponding to the value of the frequency selected by the operation panel (302), a PLL circuit (402) for generating an oscillation signal with a voltage level in response to the frequency data provided from the microprocessor (CPU) (406), and a voltage-controlled oscillator (VCO) (401) for generating a radio-frequency corresponding to the oscillation signal.

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METHOD AND APPARATUS FOR SETTING RADIO FREQUENCY FOR USE IN REMOTE CONTROLLER

Field of the Invention

The present invention relates to a method and apparatus for setting a radio frequency for use in a remote controller; and more particularly, to a method and apparatus, which employ a phase locked loop circuit in setting a radio frequency by using a remote controller for controlling a model plane or a model car, so as to overcome inconvenience of setting a frequency for a communication signal using a crystal replacement method in the conventional remote controller, and to enable a user to easily set a programmed use frequency by a key input operation.

Description of the Prior Art

In general, it has been popular for children and adults to operate model planes, model boats or model cars.

A user remotely controls the model planes, the model boats or the model cars by using a technique which transmits and receives a radio frequency signal.

Fig. 1 is a view showing an external view of a conventional remote controller.

The conventional remote controller 100 includes a crystal 102, a band pass filter 104, a crystal terminal 106, a throttle controller 108, a steering controller 110, an antenna 112, and a power supply switch 114. The crystal 102 generates an oscillating signal. The band pass filter 104 determines a frequency band of a radio frequency signal. The crystal terminal 106 contributes to replace the crystal 102 and the band pass filter 104 with another, so that the conventional remote controller 100 can operate in a signal with a different frequency. A user may use the throttle controller 108 to input commands for moving a model car forward or backward, and may use the steering controller 110 to input commands for moving the model car left or right. The antenna 112 transmits the radio frequency signal. Electric power can be supplied by operating the power supply switch 114.

In the conventional remote controller 100, the

throttle controller 108 has a form of a straight lever which can be pushed forward or pulled backward. The steering controller 110 also has a form of a straight lever which can be pushed leftward or rightward.

Moving the model car forward by an operation of the throttle controller 108 in the conventional remote controller 100 means moving the model car in a front direction. Similarly, moving the model car backward means moving the model car to a direction opposite to the forward direction of the model car, that is, to move the model car in a backward direction in relation to the model car.

In changing the direction of movement of the model car, a steering wheel of the model car can be turned to left by operating the steering controller 110 to left. Also, the steering wheel of the model car can be turned to right by operating the steering controller 110 to right.

When the user operates the throttle controller 108 and the steering controller 110 of the conventional remote controller 100, a frequency signal corresponding to each operation is generated, and is then outputted as a radio frequency signal through the antenna 214. That is, when the user pushes the throttle controller 108 forward, a radio

frequency signal for moving the model car forward is outputted through the antenna 112. In contrast, when the user pulls the throttle controller 108 backward, a radio frequency signal for moving the model car backward is outputted through the antenna 112.

In the same manner, when the user moves the steering controller 110 leftward, a radio frequency for moving the model car leftward is outputted through the antenna 112. When the user moves the steering controller 110 rightward, a radio frequency for moving the model car rightward is outputted through the antenna 112.

The conventional remote controller 100 includes the crystal 102 and the band pass filter 104 for use in generatng a signal having a frequency corresponding to each operation.

FIG. 2 is a block diagram schematically showing an internal configuration of the conventional remote controller 100 shown in FIG. 1.

The conventional remote controller 100 includes a crystal oscillator 202, a radio transmitter 204, an antenna 214, a program memory 216 and a microprocessor (CPU) 218. The crystal oscillator 202 generates a frequency signal

according to a voltage signal. The radio transmitter 204 eliminates noise included in the frequency signal from the crystal oscillator 202, and amplifies and outputs the frequency signal from which the noise has been eliminated as a radio frequency signal. The antenna 214 transmits the radio frequency signal from the radio transmitter 204. The program memory 216 stores an operation program of the conventional remote controller 100. The CPU 218 controls the steering function of the conventional remote controller 100 and outputs a voltage signal to the crystal oscillator 202 when it receives an input signal from either the throttle controller 108 or the steering controller 110.

The crystal oscillator 202 includes a crystal 102 and a band pass filter 104. The crystal oscillator 202 generates a frequency signal by means of the crystal 102 in a frequency band determined by the band pass filter 104.

The radio transmitter 204 includes a first filter 206, a first amplifier 208, a second filter 210, and a second amplifier 212. The first filter 206 eliminates a noise component included in the frequency signal from the oscillator 202. The first amplifier amplifies the frequency signal filtered by the first filter 206. The second filter

210 eliminates a noise component included in the frequency signal amplified by the first amplifier 208. The second amplifier 212 amplifies the frequency signal filtered by the second filter 210.

In an operation of the conventional remote controller 100 having the construction described above, when a user operates the throttle controller 108 and the steering controller 110, a voltage signal according to the operation is provided to the CPU 218. The CPU 218 provides another voltage signal corresponding to the voltage signal to the crystal oscillator 202. The crystal oscillator 202 generates a frequency signal according to the voltage signal from the CPU 218. The first filter 206 and the second filter 210 filter noise included in the frequency signal, and the first amplifier 208 and the second amplifier 212 amplify the frequency signal, so that a radio frequency signal is outputted through the antenna 214.

The radio frequency signal outputted from the remote controller 100 is provided for a model car having a receiver therein. When the radio frequency signal received from the remote controller 100 is a forward signal in a state that the model car is turned on, a driving motor is rotated in a

forward direction. The driving motor is connected to a forward wheel. When the radio frequency signal received from the remote controller 100 is a back signal in a state that the model car is turned on, a driving motor is rotated in a backward direction. Accordingly, the model car moves in forward/back directions.

In general, the remote controller 100 uses a frequency of 27 MHz band, a frequency of 40 MHz band, and a frequency of 75 MHz band. In order to use one of these bands, the crystal oscillator 202 has a band pass filter 104 which enables a signal of a desired frequency band to be generated. Further, the band pass filter 104 is provided with a separate crystal which enables use of a more detailed frequency selected from the frequency band of the band pass filter 104. For example, in a state that a band pass filter of 27 MHz band is installed and a crystal for generating a frequency of 27.005 MHz is installed, in order to use a frequency of 27.025 MHz, the crystal for generating a frequency of 27.005 MHz should be replaced by a crystal for generating a frequency of 27.025 MHz.

However, when at least two users use the same frequency in a remote controller for controlling a model car

or a model plane, an electric wave interruption due to mutual frequency interference occurs, causing erroneous operation of the model car or the model plane. In order to prevent such erroneous operation of a model car or a model plane, the remote controllers 100 should use band pass filters 104 and crystals 102 having different frequency bands or different frequencies.

Therefore, in the case of the conventional remote controller employing a replacement method for the crystals 102 as described above, a user must purchase a plurality of crystals with different frequencies and use a crystal having a frequency different from that of another crystal installed in a remote controller used by another person, according to the situation. Furthermore, since the crystal is weak to shock, it can be easily broken. When the user replaces a crystal and sets a frequency at an outdoor place where the model plane or the model car is operated, the size of the crystal is small and thus the crystal is apt to be lost. Therefore, it is necessarily very inconvenient for the user to set a frequency of the remote controller using the crystal substitution method.

Summary of the Invention

Therefore, the present invention has been made in view of the above-mentioned problems, and it is an object of the present invention to provide a method and apparatus for setting a radio frequency for use in a remote controller for a model plane or a mode car, which employ a PLL circuit and a frequency change program, so as to enable a user to easily view an LCD screen and change a radio frequency.

According to an aspect of the present invention, there is provided apparatus for setting a radio frequency for use in a remote controller, and the apparatus programmatically set a remote controller frequency according to a user's key input, the apparatus comprising: an operation key panel including a plurality of operation keys for selecting a plurality of functions or setting a user frequency; a program memory for storing frequency set data corresponding to a frequency selected by a key input of the operation key panel and a frequency set operation program; a microprocessor for reading frequency set data corresponding to the key input of the operation key panel from the program

memory according to the frequency set operation program stored in the program memory 404, and providing the read frequency set data to a phase locked loop circuit in order to control a frequency setting operation; the phase locked loop circuit for generating a frequency oscillating signal with a voltage level in response to the frequency data from the microprocessor; an oscillator for generating a frequency signal corresponding to the frequency oscillating signal from the phase locked loop circuit; and an antenna for transmitting the frequency signal from the oscillator as a radio frequency signal.

There is also provided a method for setting a radio frequency for use in a remote controller, the method comprising the steps of: (a) displaying mode contents set in the remote controller on an initial screen; (b) executing a function mode having a use frequency setting; (c) selecting a use frequency set function from the function mode; (d) displaying a plurality of frequency lists for setting a use frequency; (e) selecting a frequency to be set using the operation key panel; (f) providing selected frequency set data to the phase locked loop circuit; (g) generating a frequency oscillating signal corresponding to the selected

frequency set data by the phase locked loop circuit; and (h) providing the frequency oscillating signal generated by the phase locked loop circuit to the voltage controlled oscillator.

Preferably, the frequency set data are stored in one area of the program memory in a form of binary data, and a frequency set operation program formed by a "C", "C++", a "JAVA", or assembly language are stored in the other area of the program memory. More preferably, the operation key panel includes a mode key for selecting an operation mode, an enter key for inputting selections of the operation key, a down key for downing selecting bars located in each menu, an up key for upping the selecting bars located in each menu, and a reducing key for reducing all kinds of numerical values necessary in a set operation, and an increasing key for increasing all kinds of the numerical values.

Most preferably, the phase locked loop circuit includes a reference counter and a programmable divider, and the phase locked loop circuit operates the reference counter and the programmable divider according to the frequency set data from the microprocessor to generate the frequency oscillating signal, and transmits the frequency oscillating

signal to the oscillator. Also, the programmable divider includes a 5 bit swallow counter, a 12 bit programmable counter, and a 2 bit group code, and the programmable divider selectively includes a 14 bit option control counter.

In accordance with the present invention, the present invention easily and programmatically set a use frequency according to a user's key input by a phase locked loop circuit in a remote controller which controls a model car or a model plane. It is unnecessary to install a plurality of crystals for setting various radio frequencies. An inconvenience due to a crystal substitution manner is solved.

Brief Description of the Drawings

The foregoing and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a view showing an external view structure of a conventional remote controller;

FIG. 2 is a block diagram showing an internal

configuration of the conventional remote controller;

FIG. 3 is a view showing an external view configuration of a remote controller according to an embodiment of the present invention;

FIG. 4 is a block diagram showing an internal configuration of the remote controller according to an embodiment of the present invention;

FIGs. 5 and 6 are flow charts illustrating a method for setting a radio frequency for use in a remote controller according to an embodiment of the present invention;

FIG. 7 is a view showing an initial screen which is displayed on an liquid crystal display;

FIG. 8 is a view showing a screen which selects one of a plurality of frequency lists;

FIG. 9 is a view showing a use frequency 27 MHz band of a remote controller according to a region;

FIG. 10 is a view showing a configuration of a reference counter which oscillates a frequency of a phase locked loop circuit; and

FIG. 11 is a view showing a configuration of a programmable divider which oscillates a frequency of a phase locked loop circuit.

Detailed Description of the Invention

Reference will now be made in detail to the preferred embodiments of the present invention.

FIG. 3 is a view showing an external view configuration of a remote controller 300 according to an embodiment of the present invention. Some elements in FIG. 3, which are the same as those of FIG. 1, will be designated by the same reference numerals, and repetition of the description about them will be omitted.

The remote controller 300 according to the present invention includes an operation key panel 302, a steering stick 304, a throttle stick 306, a range angle dial 308, a battery case 310, and a liquid crystal display device 312. The operation key panel 302 includes a plurality of operation keys for selecting a plurality of functions or setting a user frequency. The steering stick 304 enables a user to steer a model car leftward or rightward. The throttle stick 306 enables a user to move the model car forward or backward. The range angle dial 308 is used to

set a steering range of the steering stick 304. The battery case 310 receives a charging battery (not shown) which supplies electric power necessary in an operation of the remote controller 300. The liquid crystal display (LCD) device 312 displays an operation status of the remote controller and a key input status for setting a frequency.

It is preferred that the battery housed in the battery case 310 is a rechargeable battery. The electric power from the battery is supplied to each part of the remote controller 300 through electric wires (not shown). The battery can be detachably assembled with a body of the remote controller 300.

FIG. 4 is a block diagram showing an internal configuration of the remote controller 300 according to an embodiment of the present invention.

Some elements in FIG. 4, which are the same as those of FIGs. 1 through 3, are designated by the same reference numerals and have been described already, and so repetition of the description on these elements will be omitted.

The remote controller 300 according to the present embodiment includes an oscillator 401, a Phase Locked Loop Integrated Circuit (PLL circuit) 402, a program memory 404,

a microprocessor (CPU) 406, and a power supply section 408. The oscillator 401 generates a frequency signal according to a voltage signal. The PLL circuit 402 generates a frequency oscillating signal corresponding to frequency set data which have been inputted through and supplied from the operation key panel 302. The program memory 404 stores programs for the operation of the remote controller 300 and the frequency setting operation. The microprocessor (CPU) 406 controls the control operation of the remote controller 300 according to the key input signals for the control from the operation key panel 302, and controls the frequency setting operation by applying the frequency setting data, which have been inputted through and supplied from the operation key panel 302, to the PLL circuit 402. The power supply section 408 supplies electric power to each element of the remote controller 300.

The operation key panel 302 includes a mode key 410 for a selection of an operation mode such as a control function set mode or a frequency set mode, an enter key 412 for a final input of the selected operation key, a down key 414 for scrolling a selection bar down in each menu, an up key 416 for scrolling a selection bar up in each menu, a

reducing key 418 for reducing various numerical values necessary for the setting operation, and an increasing key 420 for increasing various numerical values.

The program memory 404 has predetermined storage areas. The frequency set data are stored in one area of the program memory 404 in a form of binary data, and a frequency set operation program formed by a "C" or "C++" language are stored in the other area of the program memory 404. The frequency set operation program formed by a "JAVA" or assembly language is stored in the other area of the program memory 404.

When the operation key panel 302 processes a key input with respect to a frequency set, the CPU 406 reads frequency set data stored in the program memory 404, and displays the read frequency set data on the LCD device 312. When a function for a frequency set is selected by the operation key panel 302 and predetermined frequency set data are selected according to a key operation, the CPU 406 reads binary data corresponding to the frequency set data from the program memory 404 and transmits the read binary data to the PLL circuit 402. The PLL circuit 402 generates a frequency oscillating signal corresponding to the binary data from the

PLL circuit 402.

When the operation key panel 302 inputs a key input with respect to a frequency set to the CPU 406, the CPU 406 provides a clock signal to the PLL circuit 402 at predetermined time intervals, and provides an enable signal to the PLL circuit 402 to operate and activate the PLL circuit 402. When the operation key panel 302 inputs the binary data corresponding to the frequency set data to the PLL circuit 402 through a data line Data, the PLL circuit 402 provides a frequency generation signal corresponding to the binary data from the PLL circuit 402 to the oscillator 401 through a phase detecting line PDout.

The PLL circuit 402 operates by reading three kinds of data, including a clock signal Clock, a data signal Data, and an enable signal Enable. The reference character "Clock" represents clock input lines of 19 bit shift register and 16 bit shift register. The PLL circuit 402 reads the data at a rising edge of the clock signal. The reference character "Data" represents a serial data input line according to a binary code and a final bit of data is formed by a control bit. When the control bit is at a high level, the PLL circuit 402 sends the data to 15 bit latch.

When the control bit is at a low level, the PLL circuit 402 sends the data to 18 bit latch. The reference character "Enable" represents a load enable input line. When the "Enable" is at a high level, the PLL circuit 402 sends contents of a shift register to a latch.

Currently, the remote controller 300 employs a frequency band, one of 27 MHz band, 40 MHz band, 50 MHz band, and 75 MHz band. The program memory 404 stores frequency data corresponding to a detailed frequency channel. FIG. 9 shows the 27 MHz frequency band from among such frequency bands.

As shown in FIG. 9, it is known that the 27 MHz band has different channel frequencies according to areas in Asia, America, and Europe. The 27 MHz band uses an initial frequency of 26.975 MHz. A next channel of the initial frequency has a frequency of 26,995 MHz. The other channels subsequent to the next channel have intervals of 1.010 MHz.

The PLL circuit 402 includes a reference counter shown in FIG. 10 and a programmable divider in FIG. 11 for setting data. The PLL circuit 402 operates the reference counter and the programmable divider according to the frequency set data from the microprocessor to generate a voltage signal

corresponding to the frequency set data, that is, the frequency oscillating signal, and transmits the frequency oscillating signal to the oscillator 401.

In FIG. 10, the reference counter has a reference oscillating frequency fosc of 19.2 MHz and a reference division ratio of a channel interval s having 12.5 MHz. Accordingly, a set value R of the reference counter is a hexadecimal value obtained by dividing a reference oscillating frequency of 19.2 MHz by a channel interval of 12.5 kHz and is expressed by the following equation 1.

[Equation 1]

$$R = \frac{fosc}{s}(Hex)$$

When "1536" obtained in this manner is expressed as a hexadecimal value, the set value R of the reference counter is "600". In order to transmit the set value R of the reference counter of "600" to 14 bit binary data of the reference counter, when the set value R of the reference counter is "600" is converted into binary data, the set value R of the reference counter has a binary value of "00 1100 0000 0000". The set value R of the reference counter is allotted from LSB R1 of the reference counter having a

binary value of "00000000001100" to MSB R14 every bit.

The programmable divider shown in FIG. 11 includes a 5 bit swallow counter, a 12 bit programmable counter, and a 2 bit group code. Selectively, the programmable divider may further include a 14 bit option control counter (not shown). In FIGs. 10 and 11, numerical reference "CN" notes a control bit.

In order to obtain a binary value which is allotted to the 5 bit swallow count of the programmable divider, an N division set value of the 12 bit programmable counter should be obtained. The N division set value of the 12 bit programmable counter is a hexadecimal value of a value obtained by dividing a frequency fvco of each channel, namely, a frequency value to be set by a channel interval s, and is expressed by the following equation 2.

[Equation 2]

$$N = \frac{fosc}{s}(Hex)$$

For example, when setting the initial frequency of FIG. 9 to 26.975 MHz, the N division set value of the 12 bit programmable counter obtains "2158" by dividing a set frequency fvco by a channel interval s of 12.5 kHz. When

"2158" is expressed as a hexadecimal value, the N division set value of the 12 bit programmable counter is "86E". The N division set value of the 12 bit programmable counter is expressed as binary data of "1000 0110 1110". The N division set value of the 12 bit programmable counter is allotted from N1 of the 12 bit programmable counter having a binary value of "011101100001" to N12. The N division value obtained every set frequency in this manner is stored in the program memory 404 as the binary data.

An A division value of the swallow counter is obtained by the following equation 3. In the present invention, a prescaler value P is set to "32". However, the prescaler value P may be set to "64" or other values.

[Equation 3]

$$A = \frac{1}{2} * (fvco \div \frac{S}{2}) - P * N(Hex)$$

The A division value of the swallow counter of a hexadecimal value is obtained by the equation 3 and is converted into binary data. The binary data is allotted to 5 bit swallow counter. The A division value of the swallow counter is stored in the program memory 404 by set channel frequencies in a binary data form. That is, a set value of

a reference counter corresponding to a channel frequency shown in FIG. 8, a swallow counter value of the programmable divider, and a programmable counter value are stored in the program memory 404 in a binary data form.

A 14 bit option control counter is selectively used. The 14 bit option control counter has a binary bit with respect to an output abnormality check, a lock detection of a PLL IC, a standby mode control, a lock detection output control, a filter switch control, and a charge pump output abnormality check. A group code 2 bits G1 and G2 are binary bits indicating whether data are data of the reference counter, and data of the swallow counter, data of the option control counter.

Hereinafter, an operation of the remote controller 300 and a frequency setting operation in the remote controller will be described with reference to FIGs. 5 and 6. For better understanding of the invention, it will be assumed that the remote controller 300 according to the present invention is a remote controller which controls a model car.

A user locates the model car at a wide place where he or she can operate the model car and operates the model car using the remote controller. At this time, the user grasps

and carries the remote controller 300 in a comfortable position for operating it.

When the user turns on a power switch 114 of the remote controller, power from the power supply section 408 is supplied to each element of the remote controller. The CPU 406 becomes a standby status to control each function (step S502).

When the power is supplied to the remote controller 300, the CPU 406 displays an initial screen which has a model number 602, a model name 604, a setting level 606, a source voltage 608, a use frequency 610, and a residual amount 612 of a source voltage on the LCD device 312 as shown in FIG. 7 (step S504).

In the initial of FIG. 7, a number is given every model car by corresponding a use frequency to each model car in using the remote controller 300. When a model car is used, a number given to the model car is a model number 602 of the model car 602.

The model name 604 represents the model name of the model car which corresponds to each model number. The setting level 606 represents one of basic, standard, and expert, according to a user's operation ability level. The

source voltage 608 represents a source voltage which is used in the remote controller 300.

The residual amount 612 of a source voltage is displayed so that the user confirms an available power supply. In the present invention, when the source voltage becomes less than 8.7 V, an alarm sound and a power supply display bar are turned on and off. The user hears the alarm sound or confirms an on/off status of the power supply display bar, and charges power in a battery by viewing the residual amount 612 of a source voltage. Since a configuration which outputs the alarm sound is a general technique, it is not shown in a drawing.

The user changes the remote controller 300 to an operation mode which the user wants to use, namely, a system mode, by using operation keys of the operation key panel 302 in the initial screen status. The CPU 408 judges whether a key input with respect to a system mode set is selected by the operation key panel (step S506).

The user pushes a mode key 410 among operation keys of the operation key panel 302 in the initial screen status and pushes an enter key 412 to select a system mode. The CPU 406 recognizes inputs of the mode key 410 and the enter key

412 from the operation key panel 302, changes the remote controller 300 to a system mode according to a program stored in the program memory 404 based on the key inputs, and displays a system set screen on the LCD device 312 (step S508).

The system mode is set by simultaneously pushing the mode key 410 and the enter key 412. However, the system mode may be set by pushing other keys. The system mode is a mode which sets the model name, a neutral location trim rate, a frequency, a data copy, and an LCD screen light and dark control. A system set screen provides a set selection menu with respect to the system mode. A name is given to a model car which the user wants to control. The model name is the name given the model car. The user selects a model among an input model list.

When all the lists are not outputted on a currently displayed LCD device 312, the CPU 406 displays a scroll bar on a right screen and controls the scroll bar so that the user views the list which is not displayed on a current screen by moving the scroll bar.

The neutral location trim rate set is a menu which sets an unit of a data input for controlling a neutral

location of a servo in a neutral location in which the steering stick 304 and the throttle stick 306 are not operated. The servo is installed in a model. When the data input is set to "1", each time the user pushes the reducing key 418 or the increasing key 420 once, the data move one unit by one unit. When data is set to "2~10", each time the user pushes the reducing key 418 or the increasing key 420 once, the number datum is changed by a number of units, from 2 to 10, matching the set number.

The data copy is menu which copies a model name of a model car for receiving a radio frequency signal outputted from the remote controller. The data copy is to copy a currently set model name and data related thereto to another empty model number.

The user locates a display bar at a "frequency set" menu in a system set screen displayed on the LCD device 312 by using the up key 416 or the down 414 of the operation key panel 302 and inputs the enter key 412 in order to set a use frequency of the remote controller which the user uses.

Referring to FIG. 6, when a frequency set menu is selected and inputted from the operation key panel 302 (step S510), the CPU 406 output a frequency list based on

frequency channel data stored in the program memory 404, and displays a screen to select one of a plurality of frequency lists on the LCD device 312 as shown in FIG. 7 (step S512).

The user locates a selecting bar at a frequency which the user wants to set, for example, "26.995 MHz" using the up key 416 or the down key 414, and inputs the enter key 412 to select the frequency.

After a plurality of the frequency lists are displayed, when the operation key panel 302 inputs a frequency selection to the CPU 406 (step S514), the CPU 406 provides an enable signal and a clock signal to the phase locked loop circuit 402 (step S516).

Then the CPU 406 reads binary data of a reference counter value and a programmable divider value corresponding to a set frequency inputted and selected by the operation key panel 302, for example, "26.995 MHz" from the program memory 404, and provides the read binary data to the PLL circuit 402 through a data line Data(step S518). The data line Data is connected to the PLL circuit 402.

The CPU 406 provides a clock pulse to a clock line of the PLL circuit 402 at predetermined intervals and transmits frequency set binary data through the data line Data one

byte by one byte at a rising edge of the clock pulse.

The PLL circuit 402 becomes an active status which executes a phase locked function in response to the enable signal from the CPU 406. The PLL circuit 402 generates and outputs a frequency oscillating signal corresponding to set frequency data inputted through the data line Data to the oscillator 401. The frequency oscillating signal has a predetermined voltage level.

In step S514, when the operation key panel 302 does not input the frequency selection, the routine returns to step S512 and the CPU 406 continues to output a screen which selects one of a plurality of the frequency lists.

When a mode set key input other than a set key input with respect to the system mode, for example, a key input which sets a pit mode which sets a function necessary in a performance of a model car prior to operating the model car or a circuit mode which sets a function necessary during an operation of the model car is selected by the operation key panel 302 in step S506 (step S520), the CPU 406 executes a function for the other selected mode set (step S522).

The pit mode is a mode which sets a model selection function, a setting level selection function for a driving

beginner, a servo direction selection function, and a sub trim function. The model selection function is a function which sets a model of the model car. The servo direction selection function is a function which controls the model car left or right or controls a direction or a speed of a rotating car. The sub trim function is a function which determines a neutral location of a servo.

The circuit mode is a mode which sets an end point adjustment function, a response function, a steering speed function, and anti-lock brake system (ABS) function. The end point adjustment function is a function which determines an available maximum operation location during an operation of the servo. The response function is a function which adjusts an operation angle reflecting ratio according to an operation of a steering wheel. The steering speed function is a function which determines a servo operation speed with respect to an operation speed of the steering wheel. The ABS function is a function which improves a performance of a brake by repeating grasping and leaving operations according to an input value when a servo sticks a brake pad to a lining according to an operation of the brake during a braking operation.

The servo is moved left and right at an angle of a maximum 30°. The servo is set to 25° or 20° at need using the end point adjustment function. When the steering wheel is rotated at 10°in a standard setting, the servo is rotated at 10°. When the steering wheel is set from 5°to 20°using the response function, an operation sensitivity of the steering wheel is precisely set. When the steering wheel is rotated at a speed of 50°per second, the servo is rotated at a speed of 50°per second at a value less than a standard value. The steering speed function is a function which reduces the speed of the servo to 40°per second or 30°per second.

After a system set screen is displayed on the LCD device 312, when the user inputs and selects a function other than the frequency set function (step S524), the CPU 406 provides a screen which sets the selected function and sets the selected function according to selected and set data (step S526). The other functions include a function for setting the model name of the model car, a neutral location input trim rate set function, a data copy function, or an LCD screen bright and dark adjustment function. When the other functions are not set in step S524, step S508 of

FIG. 5 is executed through a tap B.

In accordance with the present invention, the PLL circuit 402 is included in an internal circuit of the remote controller. The CPU 406 provides frequency set data to the PLL circuit 402 according to a user's frequency set key input. The PLL circuit 402 provides a frequency oscillating signal corresponding to the frequency set data to the oscillator 401. Accordingly, a frequency signal corresponding to data which the user selects and inputs is generated to embody a method and apparatus for setting a radio frequency for use in a remote controller.

Industrial Application

As can be seen from the foregoing, according to the present invention, the method and apparatus for setting a radio frequency for use in a remote controller are used for a remote controller which controls a model device such as a model car, a model plane, and a model boat. The method and apparatus for setting a radio frequency for use in a remote controller is used for a robot controller which is remotely controlled. Therefore, the present invention is used to

conveniently set a use frequency thereof.

What is claimed is:

1. An apparatus for programmatically setting a remote controller frequency according to a user's key input, the apparatus comprising:

an operation key panel including a plurality of operation keys for selecting a plurality of functions or setting a user frequency;

a program memory for storing frequency set data corresponding to a frequency selected by a key input of the operation key panel and a frequency set operation program;

a microprocessor for reading frequency set data corresponding to the key input of the operation key panel from the program memory according to the frequency set operation program stored in the program memory, and providing the read frequency set data to a phase locked loop circuit in order to control a frequency setting operation;

a phase locked loop circuit for generating a frequency oscillating signal with a voltage level in response to the frequency data from the microprocessor;

an oscillator for generating a frequency signal corresponding to the frequency oscillating signal from the

phase locked loop circuit; and

an antenna for transmitting the frequency signal from the oscillator as a radio frequency signal.

2. The apparatus according to claim 1, further comprising:

a liquid crystal display device for displaying an operation status of the remote controller and an operation status of the key input by the operation key panel; and

a frequency transmitter for eliminating noise included in the frequency signal from the oscillator, and for amplifying and transmitting the frequency signal from which noise has been eliminated to the antenna.

3. The apparatus according to claim 1, wherein the frequency set data are stored in one area of the program memory in a form of binary data, and a frequency set operation program formed by a "C" or "C++" language are stored in the other area of the program memory.

4. The apparatus according to claim 1, wherein a frequency set operation program formed by a "JAVA" or

assembly language is stored in the program memory.

5. The apparatus according to claim 1, wherein the operation key panel includes a mode key for a selection of an operation mode, an enter key for a final input of the selected operation key, a down key for scrolling down a selection bar down in each menu, an up key for scrolling up the selection bar in each menu, a reducing key for reducing various numerical values necessary for the setting operation, and an increasing key for increasing various numerical values.

6. The apparatus according to claim 1, wherein the phase locked loop circuit includes a reference counter and a programmable divider, and the phase locked loop circuit operates the reference counter and the programmable divider according to the frequency set data from the microprocessor to generate the frequency oscillating signal, and transmits the frequency oscillating signal to the oscillator.

7. The apparatus according to claim 2, wherein the frequency transmitter includes a first filter for

eliminating a noise component included in the frequency signal from the oscillator, a first amplifier for amplifying the frequency signal filtered by the first filter, a second filter for eliminating a noise component included in the frequency signal amplified by the first amplifier, and a second amplifier for amplifying the frequency signal filtered by the second filter.

8. The apparatus according to claim 6, wherein the programmable divider includes a 5 bit swallow counter, a 12 bit programmable counter, and a 2 bit group code, and the programmable divider includes a 14 bit option control counter.

9. A method for setting a radio frequency for use in a remote controller, the remote controller including an operation key panel having a plurality of operation keys for selecting a plurality of functions or setting a user frequency, a liquid crystal display device for displaying an operation status of the remote controller and an operation status of the key input by the operation key panel, a program memory for storing a frequency set operation program,

a microprocessor for controlling a control operation of the remote controller and a frequency setting operation, a phase locked loop circuit for generating a frequency oscillating signal with a voltage level in response to the frequency data from the microprocessor, an oscillator for generating a frequency signal corresponding to the frequency oscillating signal from the phase locked loop circuit, and an antenna for transmitting the frequency signal from the oscillator as a radio frequency signal in order to set a use frequency according to a user's key input by means of a program, the method comprising the steps of:

(a) displaying mode contents set in the remote controller on an initial screen;

(b) executing a function mode having a use frequency setting;

(c) selecting a use frequency set function from the function mode;

(d) displaying a plurality of frequency lists for setting a use frequency;

(e) selecting a frequency to be set using the operation key panel;

(f) providing selected frequency set data to the phase

locked loop circuit;

(g) generating a frequency oscillating signal corresponding to the selected frequency set data by the phase locked loop circuit; and

(h) providing the frequency oscillating signal generated by the phase locked loop circuit to the oscillator.

10. The method according to claim 9, wherein a model number, a model name, a setting level, a source voltage, a use frequency, and a residual amount of a source voltage are displayed in step (a).

11. The method according to claim 9, wherein, in step b, when the function mode does not include the use frequency setting, a pit mode which sets a function necessary in a performance of a model car prior to operating the model car or a circuit mode which sets a function necessary during an operation of the model car is selectively executed.

12. The method according to claim 9, wherein displaying a scroll bar a right side of the screen, and

moving the scroll bar in order to view frequency lists which are not displayed on a current screen when all of the frequency lists are not displayed on the liquid crystal display device in step (d).

13. The method according to claim 9, wherein in step (e), a user arranges a selecting bar at a frequency list which the user wants to set using up and down keys, and the user inputs an enter key to select the frequency to be set.

14. The method according to claim 9, wherein in step (f), the microprocessor provides a clock signal to the phase locked loop circuit at predetermined time intervals, provides an enable signal to the phase locked loop circuit, and provides binary data corresponding to the frequency set data to the phase locked loop circuit during a rise of the clock signal.

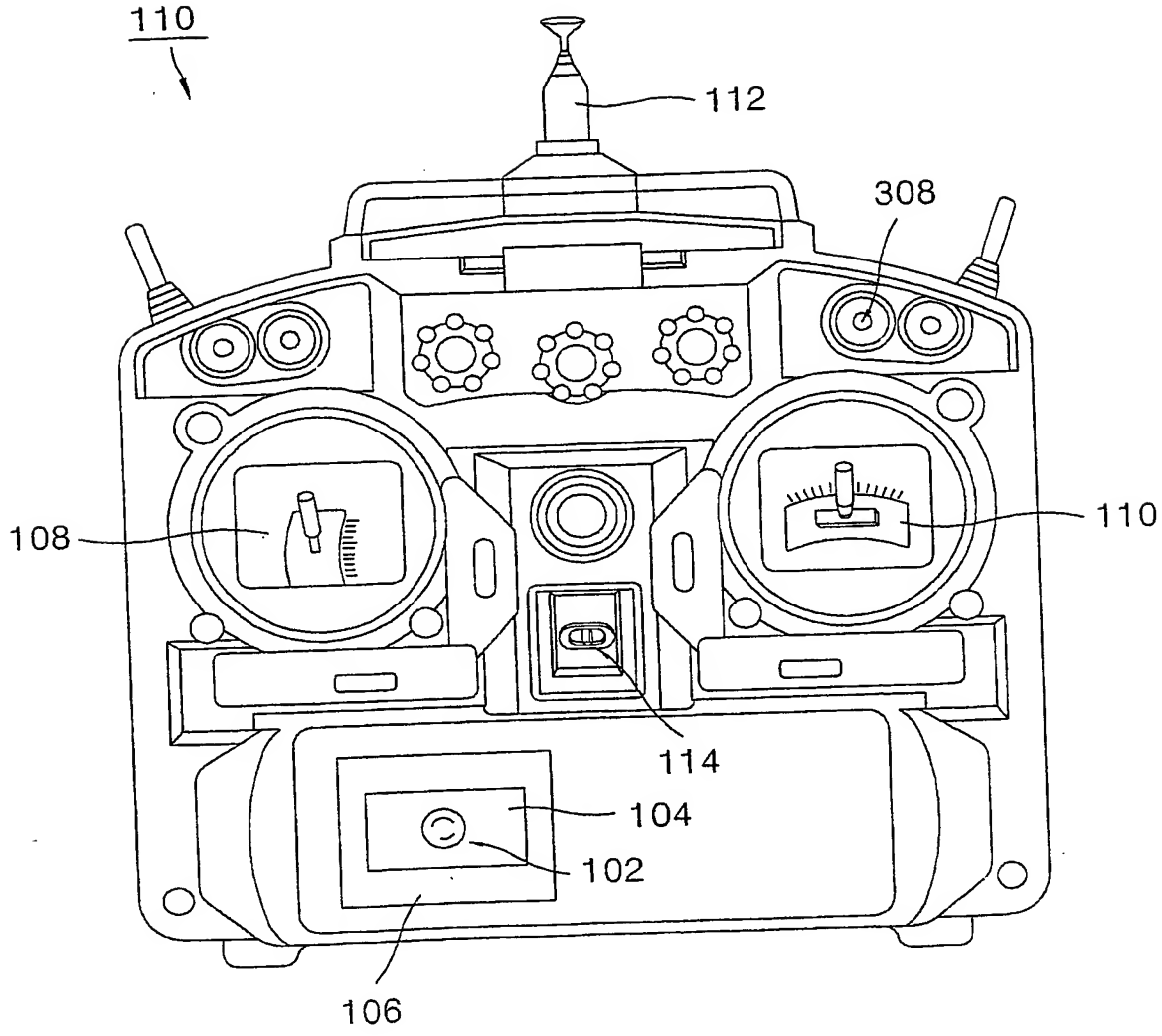

FIG. 1

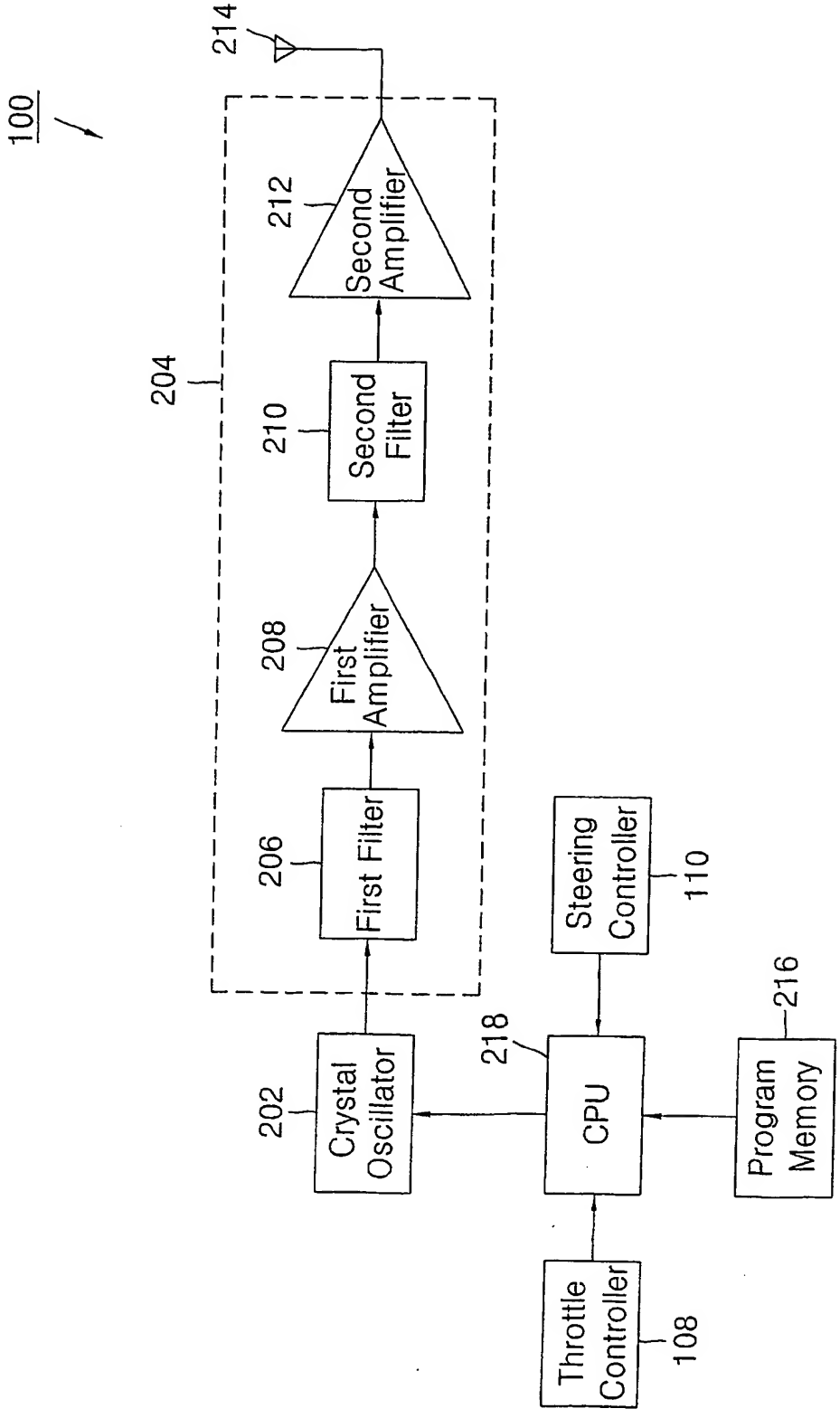
100
214
212
Second Amplifier
204
210
Second Filter
208
First Amplifier
206
First Filter
Steering Controller
110
216
218
202
Crystal Oscillator
CPU
Program Memory
Throttle Controller
108

FIG.2

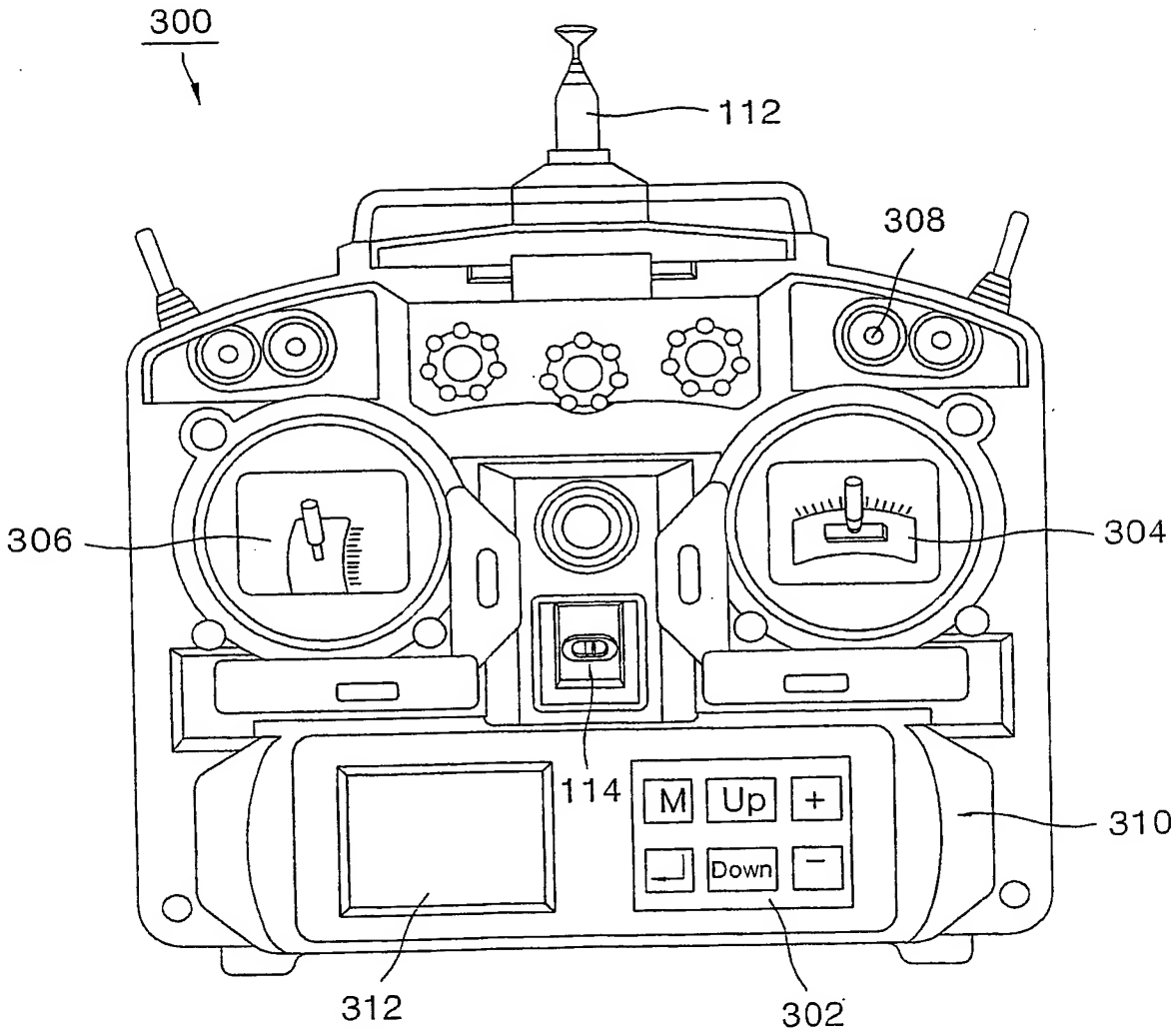

FIG.3

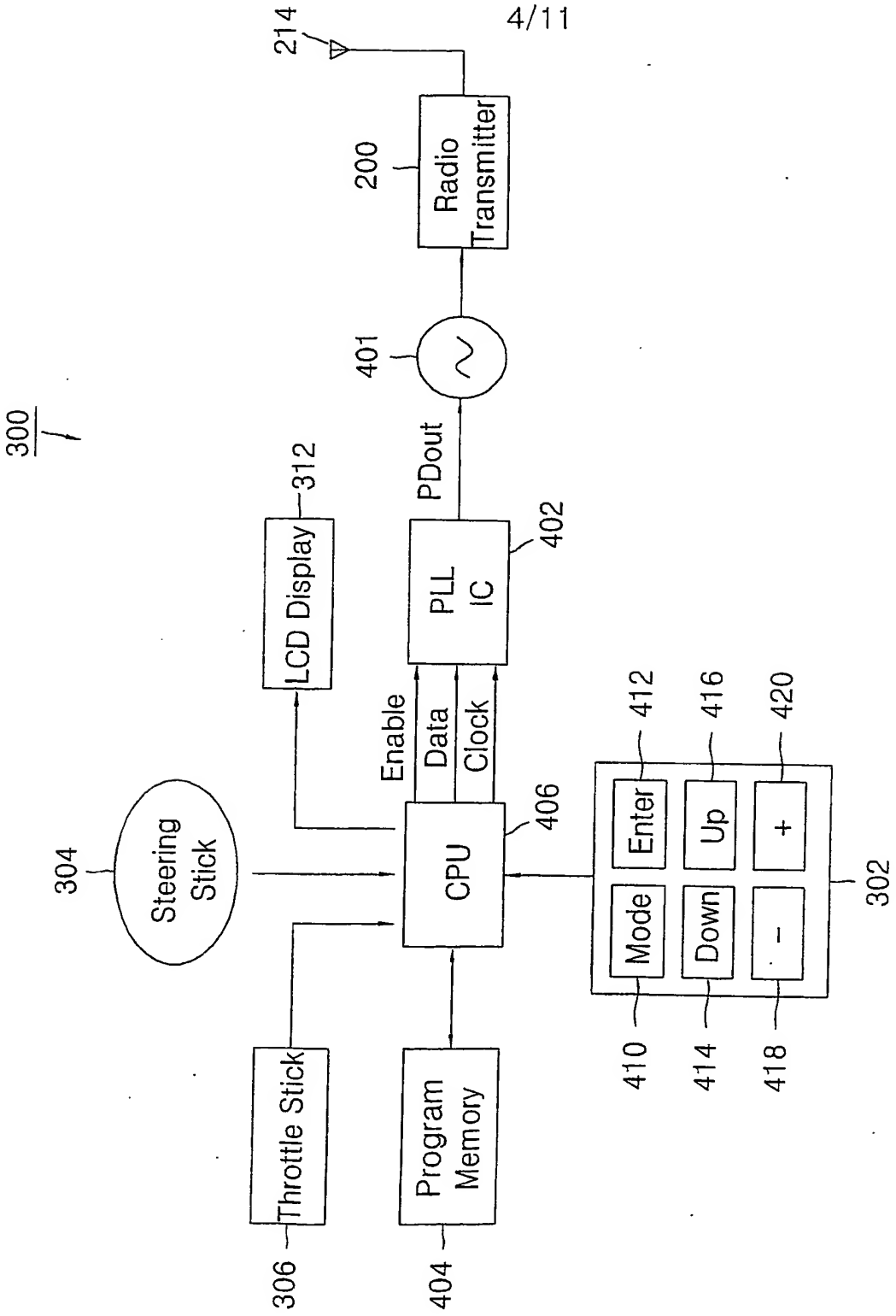
300
214
200
Radio Transmitter
401
PDout
312
LCD Display
402
PLL IC
Enable
Data
Clock
406
CPU
304
Steering Stick
412
416
420
Enter
Up
+
Mode
Down
-
302
410
414
418
306
Throttle Stick
404
Program Memory

FIG. 4

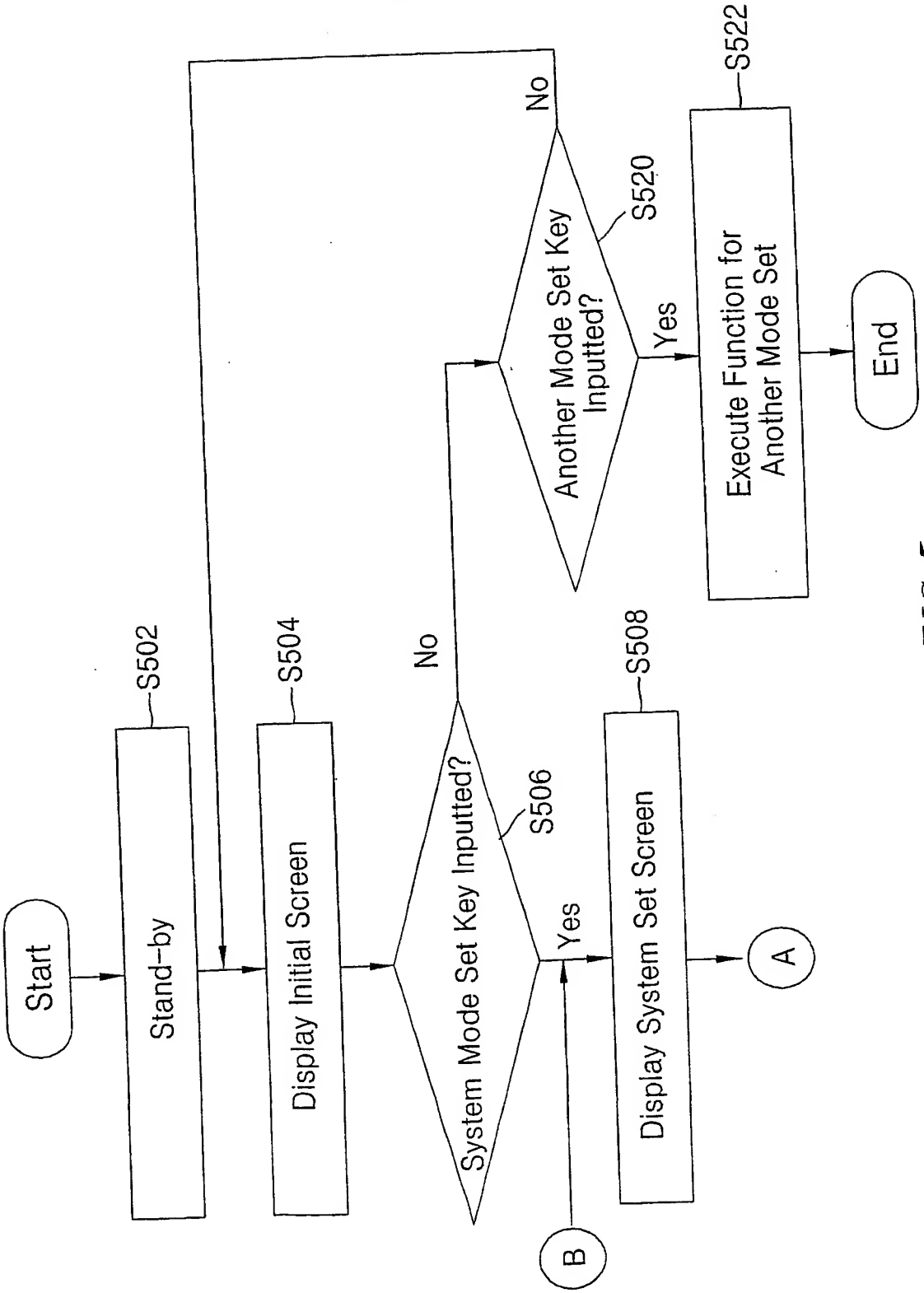
Start
Stand-by
S502
Display Initial Screen
S504
System Mode Set Key Inputted?
S506
No
Yes
B
Display System Set Screen
S508
A
Another Mode Set Key Inputted?
S520
No
Yes
Execute Function for Another Mode Set
S522
End

FIG.5

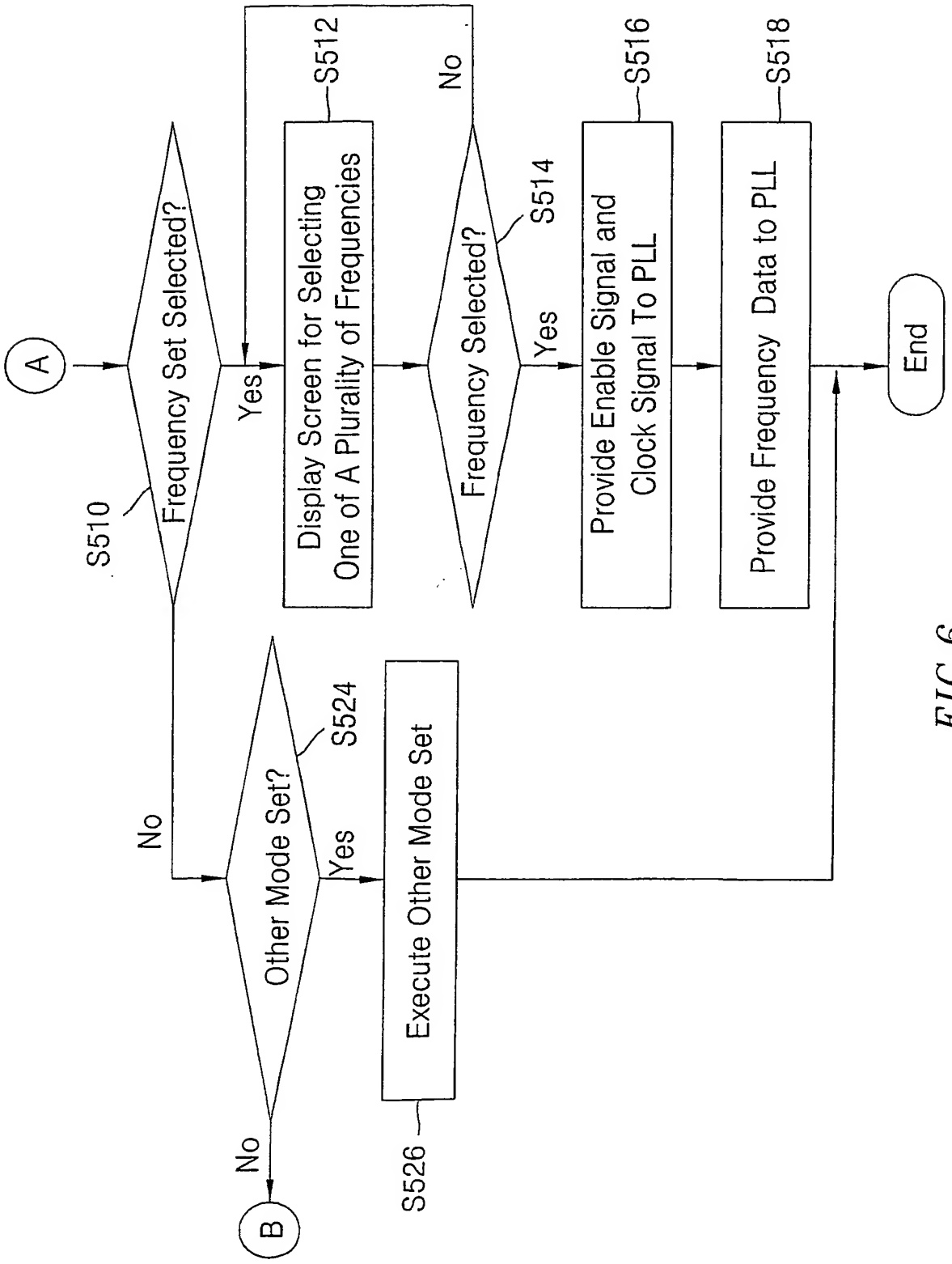
A
S510
Frequency Set Selected?
Yes
S512
Display Screen for Selecting One of A Plurality of Frequencies
No
S514
Frequency Selected?
Yes
S516
Provide Enable Signal and Clock Signal To PLL
S518
Provide Frequency Data to PLL
End
No
S524
Other Mode Set?
Yes
S526
Execute Other Mode Set
No
B

FIG. 6

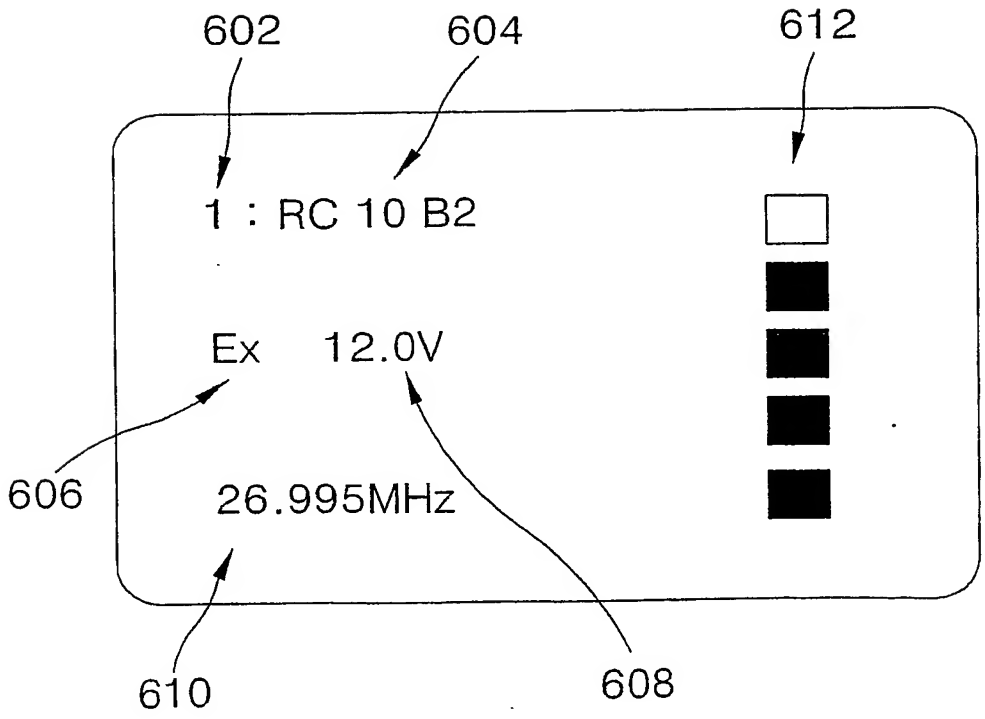

FIG. 7

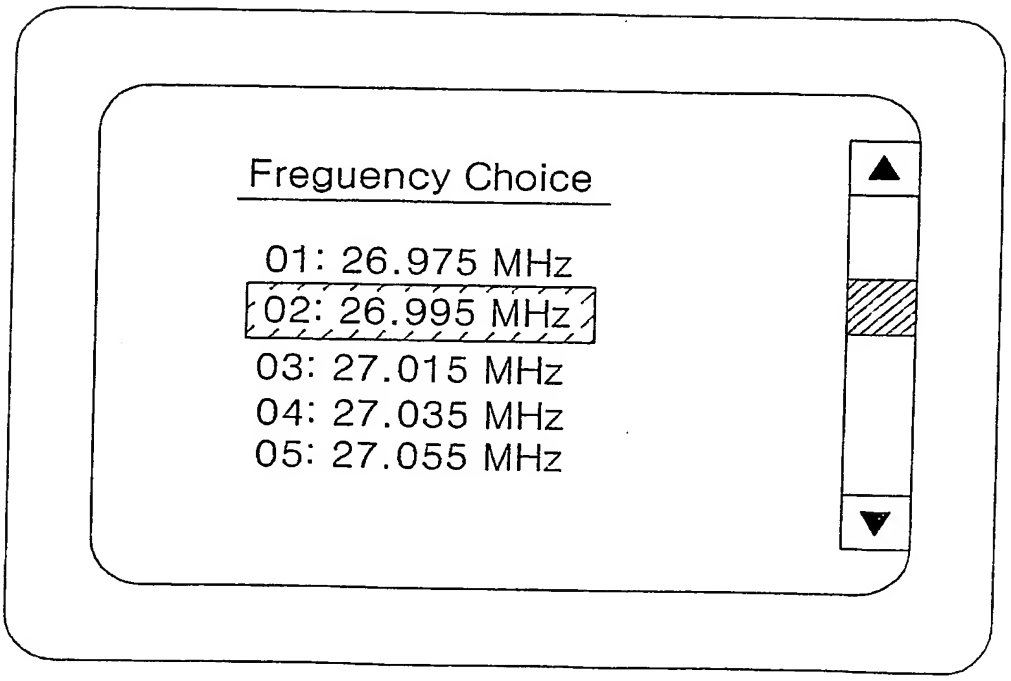
Freguency Choice
01: 26.975 MHz
02: 26.995 MHz
03: 27.015 MHz
04: 27.035 MHz
05: 27.055 MHz

FIG.8

Items		27 MHz	
Frequency	Asia Region	US Region	Europe Region
26.975 MHz	01		
26.995 MHz	02	1	04
27.005 MHz			05
27.015 MHz			06
27.025 MHz	03		07
27.035 MHz			08
27.045 MHz	04	2	09
27.055 MHz			10
27.065 MHz			11
27.075 MHz	05		12
27.085 MHz			13
27.095 MHz	06	3	14
27.105 MHz			15
27.115 MHz			16
27.125 MHz	07		17
27.135 MHz			18
27.145 MHz	08	4	19
27.175 MHz	09		
27.195 MHz	10	5	24
27.225 MHz	11		
27.255 MHz	12	6	30

FIG.9

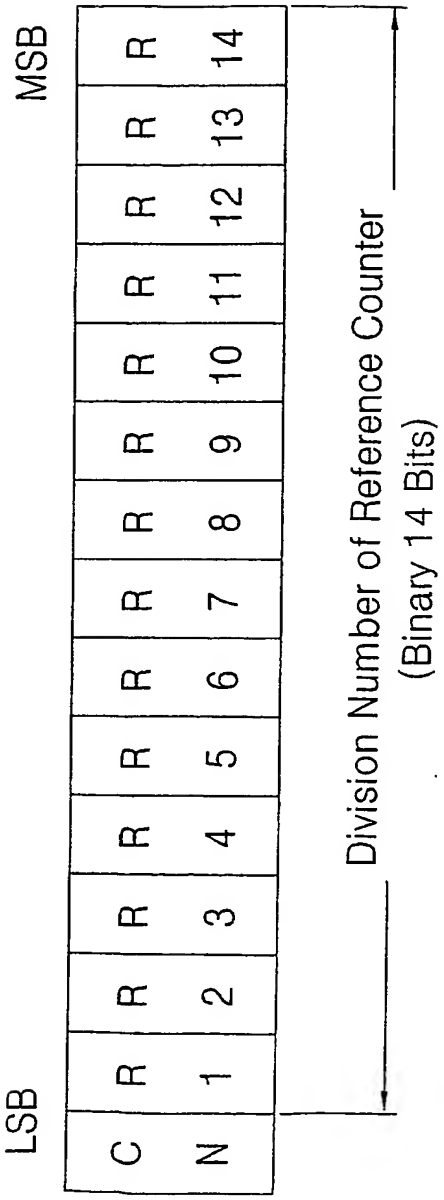
MSB
LSB
C
N
R
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Division Number of Reference Counter
(Binary 14 Bits)

FIG. 10

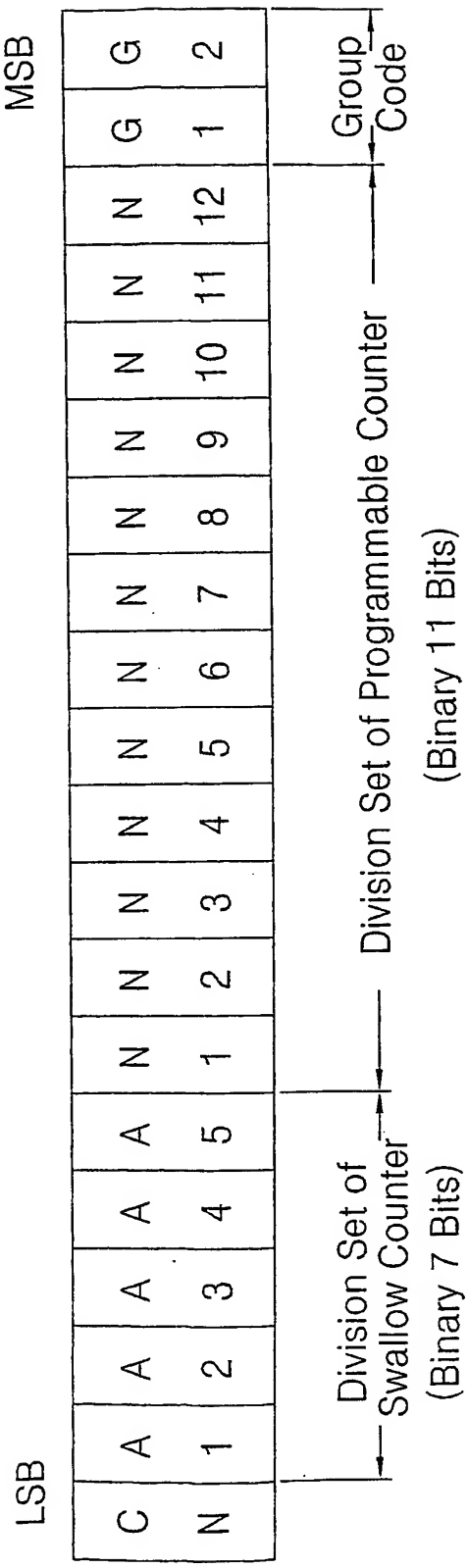
MSB
LSB
CN
A1
A2
A3
A4
A5
N1
N2
N3
N4
N5
N6
N7
N8
N9
N10
N11
N12
G1
G2
Group Code
Division Set of Programmable Counter
(Binary 11 Bits)
Division Set of
Swallow Counter
(Binary 7 Bits)

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/02132

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H04Q 9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 H04Q 9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975
Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)

KIPASS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 8-223660 A (KEYENCE CORP.) 30 AUG. 1996 see paragraph 62 - paragraph 78, fig.7 - fig.9	1-14
X	KR 10-0239863 B (FUTABA DENSHI KOGYO CORP.) 15 JAN. 2000 see fig.1, fig.6	1-8
A	JP 5-161179 A (MITSUBISHI ELECTRIC CORP.) 25 JUN. 1993	1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevence
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 AUGUST 2002 (22.08.2002)	23 AUGUST 2002 (23.08.2002)

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	MIN, Boung Joon Telephone No. 82-42-481-5746

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR01/02132

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 8-223660 A	30 AUG. 1996	NONE	
KR 10-0239863 B	1 JAN. 2000	DE 19626070 A1 JP 9018361 A2 US 5850597 A	2 JAN. 1997 17 JAN. 1997 15 DEC. 1998
JP 5-161179 A	25 JUN. 1993	NONE	